SUBJECT: INSTRUMENT OPERATION:

Extech Model 407790 as a Octave Band Analyzer (OBA)

Contents

1.0 Purpose/Scope

This procedure provides a standardized method for the calibration and operation of the *Extech Model 407790 Octave Band Analyzer (OBA)* and the *Extech 407766 Calibrator*. It should be used in conjunction with the SBMS Subject Area Noise & Hearing Conservation and IH SOP IH96200 *Noise Measurement Principles: Area Surveys.*

The *Extech 407790* meter provides a method for easy and accurate surveys of workplace noise exposures. This area survey meter is used to determine the sound pressure level at octave bands from 25 Hz to 10 kHz for posting area warnings, evaluate problem-noise sources, and measuring the effectiveness of engineering controls.

Many typical sounds are "broadband" having short, random bursts of noise at many frequencies across the full range of human hearing. These broadband noises can be broken down into the frequency contents of the noise. Values for the noise contained in adjacent bands of frequencies (octave bands – 1/1) are used to display the frequency composition of the sound. Such spectra are a signature of the noise. The bands may be further subdivided to 1/3 bands depending on the purpose of the assessment.

Materials vary in their ability to absorb different frequencies of noise. Octave band analysis allows the assessor to determine the appropriate noise abatement technique and materials.

2.0 Responsibilities

2.1 Use of the Extech OBA meter shall be limited to persons who act under the direction of a competent hazard assessment person and have demonstrated the competency to satisfactorily use the meter, as evidenced by experience and training, to the satisfaction of the qualification criteria set by BNL. See Section 7 for qualification requirements.

2.2 Personnel that perform hazard assessments and exposure monitoring with this instrument are responsible to follow all steps in this procedure.

2.3 The data collected using this meter must have an appropriate evaluation of the hazard and risk by a cognizant Industrial Hygiene professional.

3.0 Definitions

3.1 *Decibel (dB):* A non-dimensional unit used to express sound pressure levels. It is the log of the ratio of the measured sound pressure level to a reference level.

3.1.1 *dBA(L_A):* A sound pressure level in decibels made on the A-scale of a sound level meter. This unit of measure approximates the response of the human ear.

3.1.2 *dBC(L_C):* Sound pressure based on a nearly flat scale (some low frequency discrimination).

3.1.3 *dBP(L_P):* flat scale

3.2 *Frequency:* The number of cycles completed by a periodic quantity in time. Unit, hertz (Hz) measures cycles per second; perceived as the ”pitch” of the sound.

3.3 *Sound Pressure Level (SPL):* the quantity measured with a sound level meter; the intensity or perceived “loudness” of the sound.

3.4 *Impulse or Impact Noise Levels:* Variations in noise levels that involve peak levels spaced at periods of greater than one per second. Where the intervals are less than one second, it should be considered a continuous noise source.

3.5 *The 1/1 octave analysis screen:* shows 9 octave bands with center frequencies from 31.5 Hz to 8 kHz.

3.6 *The 1/3 octave analysis screen:* shows 27 octave bands with center frequencies from 25 Hz to 10 kHz.

3.7 *Occupational Exposure Limit:* The maximum time weighted average (TWA) exposure permitted for an employee, based on the lesser of the OSHA Permissible Exposure Limit (PEL: 90 dBA) or ACGIH Threshold Limit Value (TLV: 85 dBA). Also used for determining necessary actions by the employer is the OSHA Action Level of 85 dBA. See IH96200.

4.0 Prerequisites

4.1 **Training prior to using this meter:**

4.1.1 Demonstration of proper operation of the instrument as per Section 7 qualification requirements.

4.1.2 Other appropriate training for the area to be entered (check with ESH coordinator or FS Representative for the facility).

4.2 **Area Access**:

4.2.1 Contact the appropriate Facility Support Representative or Technician to obtain approval to enter radiological areas.

4.2.2 Verify with the appropriate Facility Support Representative or Technician if a Work Permit or Radiological Work Permit is needed or is in effect. If so, review and sign the permit.

4.2.3 Use appropriate PPE for area or wear hearing protection when levels are unknown.

5.0 Precautions

5.1 Hazard Determination:

5.1.1 The operation of this meter does not cause exposure to any chemical, physical, or radiological hazards. The meter design does not cause significant ergonomic concerns in routine use. The meter does not generate Hazardous Waste.

5.1.2 By its very nature, the Extech OBA meter may be used in areas where excessive noise levels exist or are suspected to be present. Exposures to noise levels above the PEL, TLV or Action Level may cause temporary or permanent hearing loss.

5.2 Personal Protective Equipment:

5.2.1 In areas where noise levels exceed, or are expected to exceed, the *Occupational Exposure Limit (OEL)*, hearing protection should be worn. The hearing protection should be able to reduce the noise levels below the OEL. See IH96200 for guidance on PPE selection.

5.2.2 Additional PPE: Other appropriate PPE for the area being entered. Check with your ES&H Coordinator or Facility Support representative.

6.0 Procedure

6.1 **Equipment:** (Pictured in Appendix 9.1)

- Meter Body
- Microphone
- Batteries (4 C alkaline)
- Windscreen (foam ball cover for microphone)
- Calibrator (Type 407766)

Operation of the Extech OBA (picture of meter and description of controls and displays is contained in Appendix 9.1.)

6.2 **Turning Power On:** slide the power switch on the right side of meter to ***ON***.

6.3 **Battery Check:** If power is low; **LBATT** flashes on the display, change batteries.

6.4 **Warm-up:** A warm-up is not required for this meter.

6.5 **Calibration:**

- Press the frequency weighting key, ***FREQ WGHT***, to read L_A in the display (SPL with A-weighting).
- Press ***TIME CONST*** to toggle between **Fast** and **Slow** response. For calibration, place in **Fast** response mode.
- Insert the microphone carefully into the insertion hole of the calibrator.
- There are two levels on the calibrator (94 dBA & 114 dBA). Slide the switch to 94 dBA. Adjust the reading on the Extech using its CAL potentiometer so that the display matches the calibrator output.

- Turn off calibrator and remove the microphone from the calibrator.
- Record results on the sample form.

6.6 **Setting up the meter response:** After calibration, the meter will be ready to take measurements as a sound pressure level meter operating in L_A, L_C or L_P modes.

- Response: Use the ***FREQ WGHT*** key to select the $\mathbf{L_A}$ reading.
- Use the ***TIME CONST*** key to select the **SLOW** setting.
- Press ***SLM:1/1:1/3*** switch to select the desired octave band or sound pressure level display.
  - For typical OBA measurements select **1/1**. This will break the noise down into 1/1 octaves with eight frequency bands of 31.5, 63, 125, 250, 500, 1K, 2K, 4K, and 8K Hz.
  - Selecting **1/3** will break the noise into 1/3 octaves**,** with twenty-seven bands of 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1K, 1.25K, 1.6 K, 2K, 2.5K, 3.15K, 4K, 5K, 6.3K, 8K and 10K Hz.

6.7 **Operator Position:** Preferably the operator should be further from the sound source than the microphone and positioned as to reduce reflection of the sound to the meter. Hold the meter at arms length.

- DO NOT stand between the sound source and microphone.
- DO NOT place the hand within 12 cm (5 inches) of the microphone.
- Take measurements at ear level of employee (sitting, standing or bending) to estimate personal exposures. Take measurements at various locations around the noise source to locate isometric lines of noise intensity on a sketch for defining area levels. Include, at a minimum: immediately adjacent to the source; any area with potential worker exposure; and to delineate the 85 dBA boundary.
- For maximum confidence in the exposure assessment, also take readings near the source and in areas that have low noise levels (background) to verify that the meter response matches these higher and lower sound pressure levels.

6.8 Using the data logger:

- Clearing old data: Turn off the instrument. Hold the ***STORE*** and ***RECALL*** buttons down while turning the instrument on. Once the screen displays memory erased, release the two keys.

6.9 Manual Datalogging:

- Press ***Memory*** button; display at top shows **M(0001)** as first record.

- Press the ***Store*** button to store the first record. This advances to the next record. Press the ***Store*** button each time a record is to be stored. To exit memory mode press the ***Memory*** button.

6.10 Automatic Datalogging:

- Press the 2nd key then the **Memory** key. Continue pressing the **Memory** key to select the sampling rate from 1 sec to 8 hours. Press the **2nd** key once a selection is made.
- Use the **SLM: 1/1: 1/3 key** to select the desired measurement screen.
- Press **Memory** then **Start/Stop** to begin automatic logging function. [S] [AUTO] appears on the screen. Press **Pause** then **Start/Stop** to end auto datalogging.

6.11 Retrieving Memory Data:

- Press ***Memory*** to enter memory mode. Press ***Recall*** to enter the recall mode. Press the ***2nd*** key then use the ***< Cursor >*** key to move through the memory cells.
- To exit Recall mode press: the ***2nd*** key; then the ***Recall*** key; then the **Memory** key.

6.12 Recording readings:

- Use the BNL Direct Reading Sampling Instrument Form to record readings (see the IH96200 for the most recent version).
- Return meter and original sampling form to the SHSD IH Laboratory daily or at the end of each project as agreed to by the IH Laboratory Technician.
- Send a copy of any hazard evaluation report written on the survey to the IH Laboratory and the Occupational Medicine Clinic.
- Perform a post calibration. Record on form.

7.0 Implementation and Training

7.1 Training prior to using this meter includes a demonstration of proper operation of the instrument based on training, education, and experience. All persons must have met the qualification criteria for IH96 Noise Assessor set in *IH50300 BNL IH Program and IH Group Training & Qualification Matrix.*

7.2 Personnel are to document their training using Attachment 9.4, the Job Performance Measure Completion Certificate. Qualification on this JPM is required on a 3 year basis, providing the professional is monitoring noise sources frequently.

7.3 A baseline audiogram may be needed if the duration of exposure to the person performing the survey will be in excess of the OSHA Permissible Exposure Limits (PEL) or ACGIH Threshold Limit Value (TLV) (which ever is less). See IH96200.

7.4 Other appropriate training for the area to be entered (check with ESH coordinator or FS Representative for the facility).

8.0 References

8.1 Extech Digital Sound Survey Meter Instructions.
8.2 Extech Acoustical Calibrator Class 2L Instructions
8.3 BNL SBMS Subject Area Noise & Hearing Conservation.
8.4 OSHA Noise/Hearing Conservation 29CFR1910.95.

9.0 Attachments

9.1 Photo of meter and parts
9.2 Theory of Operation
9.3 Short List of Operating Instructions
9.4 Job Performance Measure

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER **IH96515** REVISION **Final Rev2**
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10.0 Documentation

Document Development and Revision Control Tracking		
Prepared By: *(Signature and date on file)* **J. Peters Author** **Date 05/25/04**	**Reviewed By:** *(Signature and date on file)* **R. Selvey SHSD IH Group Leader** **Date 05/25/04**	**Approved By:** *(Signature and date on file)* **R. Selvey SHSD IH Group Leader** **Date 06/01/04**
ESH Coordinator/ Date: *none*	Work Coordinator/ Date: *none*	SHSD Manager / Date *none*
QA Representative / Date: *none*	Training Coordinator / Date: *none*	Filing Code: **IH52**
Facility Support Rep. / Date: *none*	Environ. Compliance Rep. / Date: *none*	Effective Date: **06/01/04**
ISM Review - Hazard Categorization ☐ High ☒ Moderate ☐ Low/Skill of the craft	Validation: ☐ Formal Walkthrough ☐ Desk Top Review ☐ SME Review Name / Date:	Implementation: Training Completed: Tracked in BTMS Procedure posted on Web: 11/02/05 Hard Copy files updated: 11/02/05

Revision Log		
Purpose: ☐ Temporary Change ☐ Change in Scope ☐ Periodic review ☐ Clarify/enhance procedural controls Changed resulting from: ☐ Environmental impacts ☐ Federal, State and/or Local requirements ☐ Corrective/preventive actions to non-conformances ☒ none of the above Section/page and Description of change: Revised Section 7 on qualification.		
(signature on file) Robert Selvey 07/13/04 SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:
Purpose: ☐ Temporary Change ☐ Change in Scope ☐ Periodic review ☒ Clarify/enhance procedural controls Changed resulting from: ☐ Environmental impacts ☐ Federal, State and/or Local requirements ☐ Corrective/preventive actions to non-conformances ☒ none of the above Section/page and Description of change: Revised Section 7 training requirements. Updated Section 10 to new format. Added Attachment 9.4 JPM.		
(signature/date on file) R. Selvey 11/02/05 SME Reviewer/Date:	SME Reviewer/Date:	SME Reviewer/Date:

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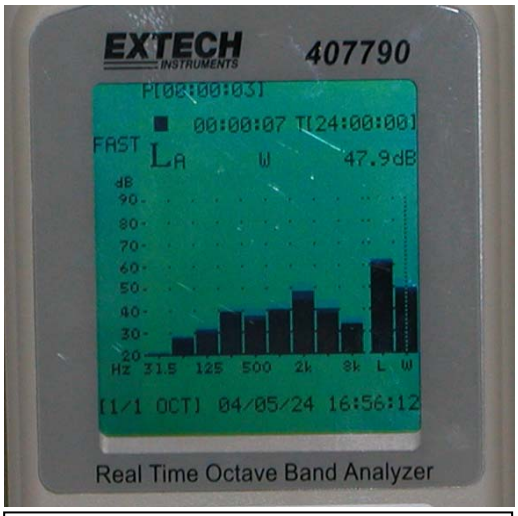
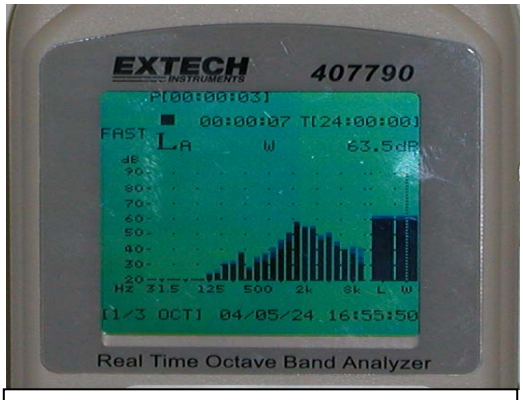
Attachment 9.1
Photo of the Meter & Calibrator

SLM Display



1/1 Octave Band Display



1/3 Octave Band Display

Attachment 9.2
Theory of Operation

The Extech OBA is a precision sound level meter which incorporates A, C and Flat weighting networks, as well as FAST and SLOW detector response.

- A reading can be captured on the digital display at the precise instant required while the meter continues to track the incoming noise level
- The digital display can be used in the continuous mode or it can be operated to capture and hold the maximum level encountered. This is extremely useful when measuring sounds of short duration or vehicle "passerby" sounds.

Weighting Networks. The meter contains three weighting networks, A, C, & P (flat), which shape the noise to discriminate against the frequency components of the measured noise.

- *A Network*: Simulates subjective responses to noise. Generally used in noise surveys to locate noise hazards. The A Network discriminates the low frequencies quite severely. Most regulations require that noise be measured on the A-weighting scale.
- *C Network*: Barely discriminates (filters) against low frequencies.
- *P Network*: No adjustment

There are two display settings for Octave Band Analysis. The *1/1 OCT* displays 9 octave bands (center frequencies are shown). The *1/3 OCT* displays 27 octave bands. The readings may be manually or automatically recorded.

If measured sound levels of noise are much higher on the C-weighting than on the A- weighting, much of the noise is contributed by the low frequencies.

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Attachment 9.3

Short Operating Instructions

	Step	User Action
1	**Power On**	Slide On/Off switch to **ON** position and wait until the measurement screen appears.
2	**Battery Check**	If **LBATT** flashes on the display replace the 4 C batteries.
3	**Calibration**	- Check calibration pre and post use. - Press the SLM button until: **SLM**; **L_A**; and **FAST** are displayed. - Insert the microphone carefully into the insertion hole of the calibrator - Turn on the calibrator and if necessary adjust the CAL potentiometer so the display matches the calibrator output. Record result on field data sheet. - Turn off the calibrator and remove from the meter.
4	**Set the meter response:**	- Press the SLM button until: **1/1 OCT or 1/3 OCT**; **L_P**; and **FAST** are displayed. - Press the TimeConst button to select **SLOW** response. In OBA mode several ranges may be selected from 20 - 130 dB using the **Level** Key.
5	**Manual Datalogging**	- Press **Memory** to begin storing information. Press the **Store** button to store the first record. This advances to the next record. - Press the **Store** button each time a record is to be stored. To exit memory mode press the **Memory** button.
6	**Recalling Stored Data**	- Press **Memory** to enter memory mode. Press **Recall** to enter the recall mode. Press the **2nd** key then use the **Cursor** key to move through the memory cells. To exit Recall mode press: the **2nd** key; then the **Recall** key; then the M**emory** key.
7	**Automatic Datalogging**	Press the 2nd key then the **Memory** key. Continue pressing the **Memory** key to select the sampling rate from 1 sec to 8 hours. Press the **2nd** key once a selection is made. Use the **SLM: 1/1: 1/3 key** to select the desired measurement screen. Press **Memory** then **Start/Stop** to begin automatic logging function. [S] [AUTO] appears on the screen. Press **Pause** then **Start/Stop** to end auto datalogging.
8	**Retrieving Auto Stored Data**	To retrieve the stored data, use the PC interface utility.
9	**Post-Calibration**	Repeat step three and record on field data sheet.
10	**Turn Off Meter**	Slide the On/Off switch to **Off.**
11	**To Erase Memory**	Turn the meter off. Press and hold both the **Store and Recall** buttons. Turn the meter **ON** and when display shows **"All Memory Erased"** release the keys.

BROOKHAVEN NATIONAL LABORATORY

IH96515 Attachment 9.4
HP-IHP-96515

Industrial Hygiene Program

Noise and Hearing Conservation
Octave Band Analysis with the Extech Model 407790

Job Performance Measure (JPM) Completion Certificate

Candidate's Name	Life Number:

Practical Skill Evaluation: Demonstration of Evaluation Methodology by Oral Exam

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
1. Hazard Analysis	Understands the need to perform a hazard analysis of the area and potential exposure to the self as sampler and workers in the area.			
2. Personal Protective Equipment	Understands the need to be aware of the potential surface contamination, airborne levels of contaminants, radiological hazards, and noise hazards. Knows how to determine the need for PPE.			
3. Sampling Equipment	Knows where equipment needed for the procedure is located and how to properly sign it out.			
6. Operating Parameters	Knows the theory to establish operating parameters (safety envelope) for the equipment.			
7. Documentation	Demonstrates correctly filling out IH monitoring forms.			

IH Noise Meter Operation - Practical Skill Evaluation

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
1. Turning the Meter On and Off	Demonstrates correctly activating the meter and turning it off			
2. Calibration of the Meter	Demonstrates correctly calibrating/bump checking the meter			
3. Clearing Stored data	Demonstrates the correctly to erase stored data			
4. Operation of taking a reading	Describes the Octave Band settings, how to change setting and obtain each weighting, and meaning of the readings			
5. Downloading stored data	Demonstrates correctly extracting stored data from the meter to paper printout and electronic storage.			
6. Clearing data after downloading	Demonstrates correctly for removing stored data for the next user.			

I accept the responsibility for performing this task as demonstrated within this JPM and the corresponding SOP.

Candidate Signature:	Date:

I certify the candidate has satisfactorily performed each of the above listed steps and is capable of performing the task unsupervised.

Evaluator Signature:	Date: